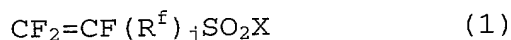


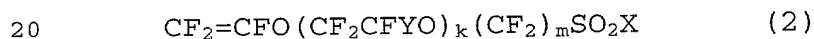
WHAT IS CLAIMED IS:

1. A solid polymer electrolyte material made of a copolymer comprising a repeating unit based on a fluoromonomer A which gives a polymer having an alicyclic structure in its main chain by radical polymerization, and a repeating unit based on a fluoromonomer B of the following formula (1):



wherein j is 0 or 1, X is a fluorine atom, a chlorine atom or OM {wherein M is a hydrogen atom, an alkali metal atom or a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$  and  $\text{R}^4$  which may be the same or different, is a hydrogen atom or a monovalent organic group)}, and  $\text{R}^f$  is a  $\text{C}_{1-20}$  polyfluoroalkylene group having a straight chain or branched structure which may contain ether oxygen atoms.

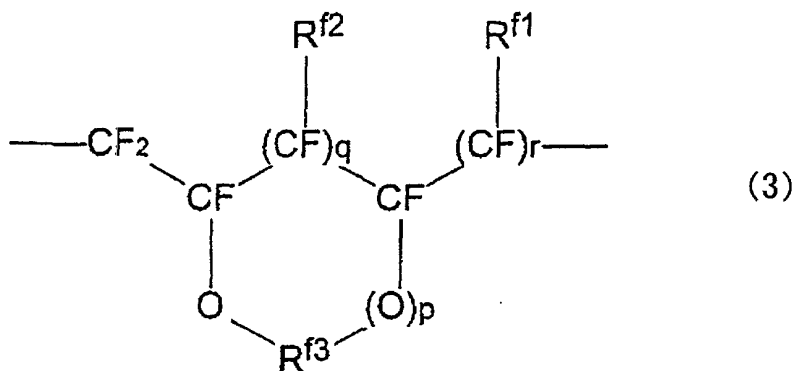
2. The solid polymer electrolyte material according to Claim 1, wherein the fluoromonomer A is a perfluoromonomer, and the fluoromonomer B is represented by the following formula (2):



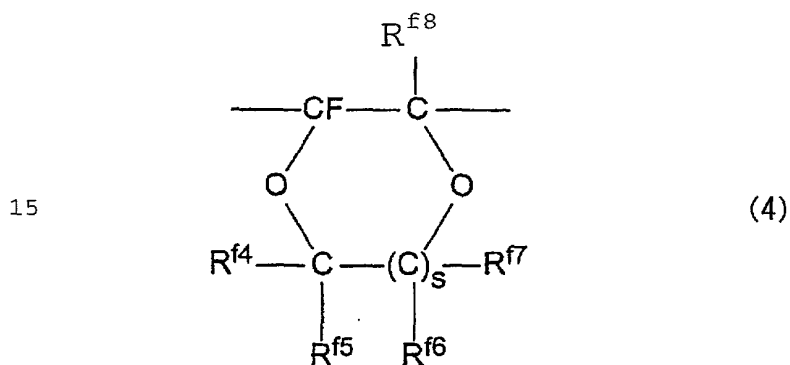
wherein k is an integer of from 0 to 2, m is an integer of from 1 to 12, Y is a fluorine atom or a trifluoromethyl group, and X has the same meaning as X in the above formula (1).

3. The solid polymer electrolyte material according to Claim 1, wherein the repeating unit based on the fluoromonomer A is represented by any one of the

following formulae (3) to (5):



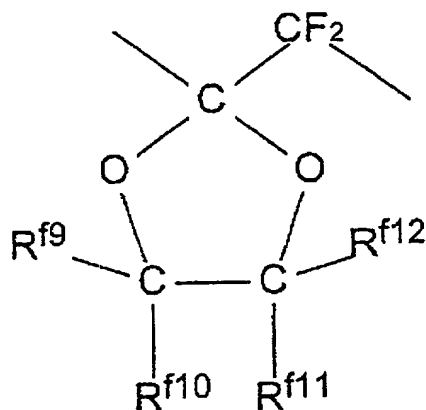
wherein each of p, q and r which is independent of one  
 5 another, is 0 or 1, each of R<sup>f1</sup> and R<sup>f2</sup> which may be the  
 same or different, is a fluorine atom, a C<sub>1-5</sub>  
 perfluoroalkyl group or a C<sub>1-5</sub> perfluoroalkoxy group, and  
 R<sup>f3</sup> is a C<sub>1-3</sub> perfluoroalkylene group which may contain a  
 C<sub>1-5</sub> perfluoroalkyl group or a C<sub>1-5</sub> perfluoroalkoxy group,  
 10 as a substituent;



wherein s is 0 or 1, each of R<sup>f4</sup>, R<sup>f5</sup>, R<sup>f6</sup> and R<sup>f7</sup> which  
 20 may be the same or different, is a fluorine atom or a C<sub>1-5</sub>

perfluoroalkyl group (provided that  $R^{f4}$  and  $R^{f5}$  may be connected to form a spiro ring when  $s$  is 0), and  $R^{f8}$  is a fluorine atom, a  $C_{1-5}$  perfluoroalkyl group or a  $C_{1-5}$  perfluoroalkoxy group; and

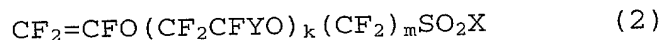
5



(5)

wherein each of  $R^{f9}$ ,  $R^{f10}$ ,  $R^{f11}$  and  $R^{f12}$  which may be the same or different, is a fluorine atom or a  $C_{1-5}$  perfluoroalkyl group.

- 10 4. The solid polymer electrolyte material according to Claim 3, wherein the fluoromonomer B is represented by the following formula (2):

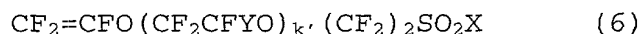


15 wherein  $k$  is an integer of from 0 to 2,  $m$  is an integer of from 1 to 12,  $Y$  is a fluorine atom or a trifluoromethyl group, and  $X$  has the same meaning as  $X$  in the above formula (1).

5. The solid polymer electrolyte material according to Claim 4, wherein the fluoromonomer A is at least one  
20 member selected from the group consisting of perfluoro(3-

butenyl vinyl ether), perfluoro(2,2-dimethyl-1,3-dioxole), perfluoro(1,3-dioxole), 2,2,4-trifluoro-5-trifluoromethoxy-1,3-dioxole and perfluoro(2-methylene-4-methyl-1,3-dioxolane), and the fluoromonomer B is

5 represented by the following formula (6):



wherein  $k'$  is 0 or 1, X has the same meaning as X in the above formula (1), and Y has the same meaning as Y in the above formula (2).

10 6. The solid polymer electrolyte material according to Claim 5, wherein the fluoromonomer A is perfluoro(2,2-dimethyl-1,3-dioxole), and in addition to the fluoromonomer A and fluoromonomer B, a repeating unit based on tetrafluoroethylene is contained.

15 7. The solid polymer electrolyte material according to Claim 1, which has an ion exchange capacity of from 0.5 to 2.5 meq/g dry resin.

8. The solid polymer electrolyte material according to Claim 1, which is a solid polymer electrolyte material  
20 wherein the  $-\text{SO}_2\text{X}$  group in the formula (1) is a  $-\text{SO}_3\text{H}$  group, and which is useful as a material constituting a solid polymer fuel cell.

9. The solid polymer electrolyte material according to Claim 8, wherein the copolymer has a softening  
25 temperature of at least  $100^\circ\text{C}$ .

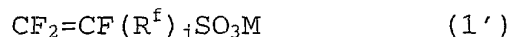
10. The solid polymer electrolyte material according to Claim 2, which is a solid polymer electrolyte material

wherein the  $-\text{SO}_2\text{X}$  group in the formula (2) is a  $-\text{SO}_3\text{H}$  group, and which is useful as a material constituting a solid polymer fuel cell.

11. The solid polymer electrolyte material according to  
5 Claim 3, which is a solid polymer electrolyte material wherein the  $-\text{SO}_2\text{X}$  group in the formula (1) is a  $-\text{SO}_3\text{H}$  group, and which is useful as a material constituting a solid polymer fuel cell.

12. The solid polymer electrolyte material according to  
10 Claim 4, which is a solid polymer electrolyte material wherein the  $-\text{SO}_2\text{X}$  group in the formula (2) is a  $-\text{SO}_3\text{H}$  group, and which is useful as a material constituting a solid polymer fuel cell.

13. A liquid composition comprising an organic solvent  
15 having a hydroxyl group in its molecule, and a solid polymer electrolyte material made of a copolymer comprising a repeating unit based on a fluoromonomer A which gives a polymer having an alicyclic structure in its main chain by radical polymerization, and a repeating  
20 unit based on a fluoromonomer B' of the following formula (1'):

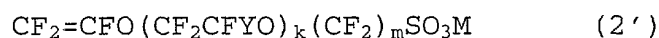


wherein  $j$  is 0 or 1,  $\text{M}$  is a hydrogen atom, an alkali metal atom or a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  
25  $\text{R}^3$  and  $\text{R}^4$  which may be the same or different, is a hydrogen atom or a monovalent organic group), and  $\text{R}^f$  is a  $\text{C}_{1-20}$  polyfluoroalkylene group having a straight chain or

branched structure which may contain ether oxygen atoms dissolved or dispersed in the organic solvent.

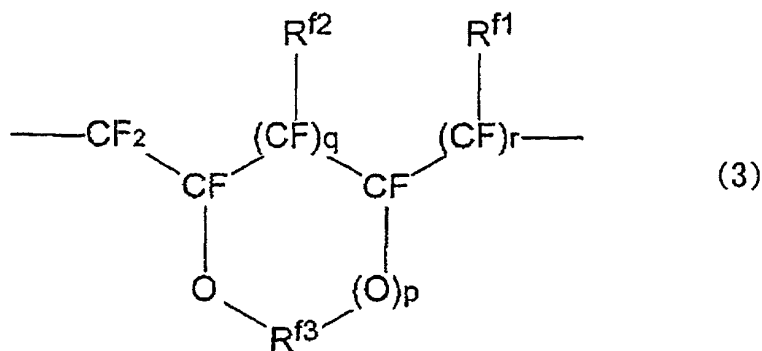
14. The liquid composition according to Claim 13, wherein the fluoromonomer B' is represented by the following

5 formula (2'), and the repeating unit based on the fluoromonomer A is represented by any one of the following formulae (3) to (5):

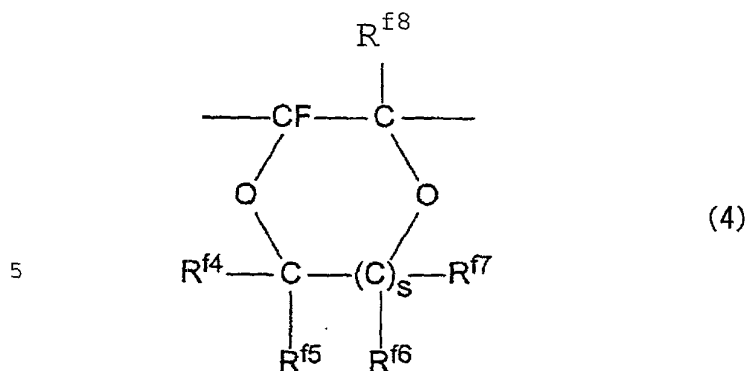


wherein k is an integer of from 0 to 2, m is an integer

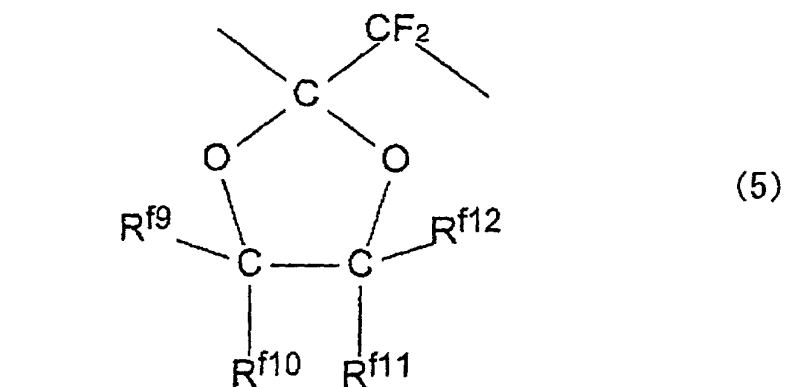
10 of from 1 to 12, Y is a fluorine atom or a trifluoromethyl group, and M has the same meaning as M in the above formula (1');



15 wherein each of p, q and r which is independent of one another, is 0 or 1, each of R<sup>f1</sup> and R<sup>f2</sup> which may be the same or different, is a fluorine atom, a C<sub>1-5</sub> perfluoroalkyl group or a C<sub>1-5</sub> perfluoroalkoxy group, and R<sup>f3</sup> is a C<sub>1-3</sub> perfluoroalkylene group which may contain a  
20 C<sub>1-5</sub> perfluoroalkyl group or a C<sub>1-5</sub> perfluoroalkoxy group, as a substituent;



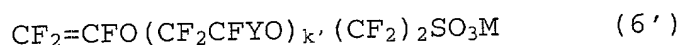
wherein  $s$  is 0 or 1, each of  $R^{f4}$ ,  $R^{f5}$ ,  $R^{f6}$  and  $R^{f7}$  which may be the same or different, is a fluorine atom or a  $C_{1-5}$  perfluoroalkyl group (provided that  $R^{f4}$  and  $R^{f5}$  may be  
 10 connected to form a spiro ring when  $s$  is 0), and  $R^{f8}$  is a fluorine atom, a  $C_{1-5}$  perfluoroalkyl group or a  $C_{1-5}$  perfluoroalkoxy group; and



wherein each of  $R^{f9}$ ,  $R^{f10}$ ,  $R^{f11}$  and  $R^{f12}$  which may be the same or different, is a fluorine atom or a  $C_{1-5}$  perfluoroalkyl group.

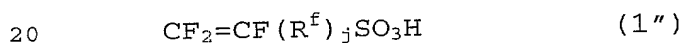
15. The liquid composition according to Claim 14, wherein  
 20 the fluoromonomer A is at least one member selected from

the group consisting of perfluoro(3-butenyl vinyl ether),  
perfluoro(2,2-dimethyl-1,3-dioxole), perfluoro(1,3-  
dioxole), 2,2,4-trifluoro-5-trifluoromethoxy-1,3-dioxole  
and perfluoro(2-methylene-4-methyl-1,3-dioxolane), and  
5 the fluoromonomer B' is represented by the following  
formula (6'):



wherein  $k'$  is 0 or 1, M has the same meaning as M in the  
above formula (1'), and Y has the same meaning as Y in  
10 the above formula (2).

16. A solid polymer fuel cell comprising an anode, a  
cathode and a polymer electrolyte membrane disposed  
between the anode and the cathode, wherein the cathode  
contains, as a constituting material, a solid polymer  
15 electrolyte material made of a copolymer comprising a  
repeating unit based on a fluoromonomer A which gives a  
polymer having an alicyclic structure in its main chain  
by radical polymerization, and a repeating unit based on  
a fluoromonomer B' of the following formula (1''):

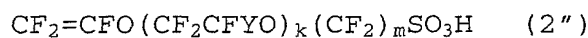


wherein  $j$  is 0 or 1, and  $\text{R}^f$  is a  $\text{C}_{1-20}$  polyfluoroalkylene  
group having a straight chain or branched structure which  
may contain ether oxygen atoms.

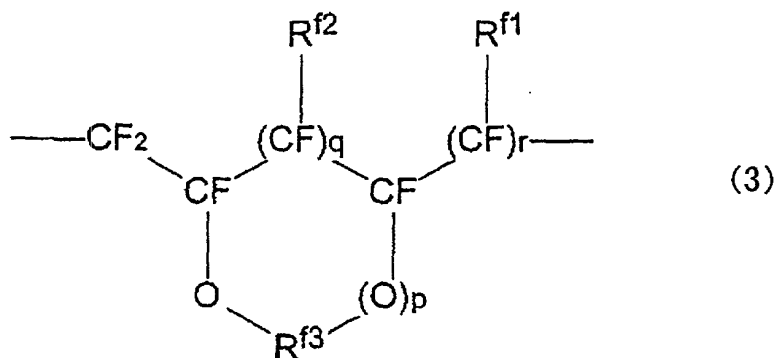
17. The solid polymer fuel cell according to Claim 16,  
25 wherein the fluoromonomer B' is represented by the  
following formula (2''), and the repeating unit based on  
the fluoropolymer A is represented by any one of the



following formulae (3) to (5):

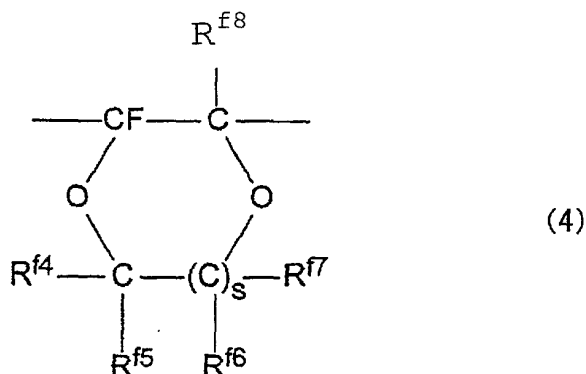


wherein k is an integer of from 0 to 2, m is an integer of from 1 to 12, and Y is a fluorine atom or a trifluoromethyl group;

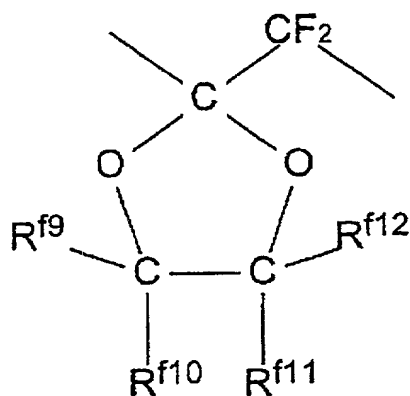


wherein each of p, q and r which is independent of one another, is 0 or 1, each of  $\text{R}^{\text{f}1}$  and  $\text{R}^{\text{f}2}$  which may be the same or different, is a fluorine atom, a  $\text{C}_{1-5}$

perfluoroalkyl group or a  $\text{C}_{1-5}$  perfluoroalkoxy group, and  $\text{R}^{\text{f}3}$  is a  $\text{C}_{1-3}$  perfluoroalkylene group which may contain a  $\text{C}_{1-5}$  perfluoroalkyl group or a  $\text{C}_{1-5}$  perfluoroalkoxy group, as a substituent;



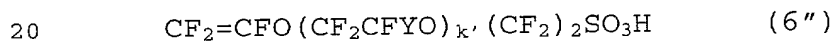
wherein s is 0 or 1, each of  $R^{f4}$ ,  $R^{f5}$ ,  $R^{f6}$  and  $R^{f7}$  which may be the same or different, is a fluorine atom or a  $C_{1-5}$  perfluoroalkyl group (provided that  $R^{f4}$  and  $R^{f5}$  may be  
 5 connected to form a spiro ring when s is 0), and  $R^{f8}$  is a fluorine atom, a  $C_{1-5}$  perfluoroalkyl group or a  $C_{1-5}$  perfluoroalkoxy group; and



(5)

wherein each of  $R^{f9}$ ,  $R^{f10}$ ,  $R^{f11}$  and  $R^{f12}$  which may be the  
 10 same or different, is a fluorine atom or a  $C_{1-5}$  perfluoroalkyl group.

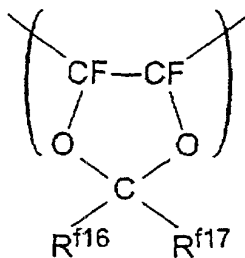
18. The solid polymer fuel cell according to Claim 17, wherein the fluoromonomer A is at least one member selected from the group consisting of perfluoro(3-butenyl  
 15 vinyl ether), perfluoro(2,2-dimethyl-1,3-dioxole), perfluoro(1,3-dioxole), 2,2,4-trifluoro-5-trifluoromethoxy-1,3-dioxole and perfluoro(2-methylene-4-methyl-1,3-dioxolane), and the fluoromonomer B' is represented by the following formula (6''):



wherein  $k'$  is 0 or 1, and Y has the same meaning as Y in the above formula (2).

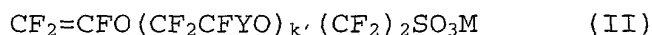
19. A fluoropolymer which is a copolymer consisting essentially of a repeating unit of the following formula

5 (I) and a repeating unit based on a fluoromonomer D of the following formula (II), wherein the content of the repeating unit based on the fluoromonomer D is from 10 to 75 mol%, and the number average molecular weight is from 5,000 to 5,000,000:



(I)

10

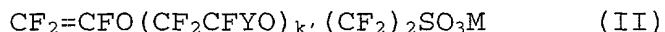


wherein each of  $\text{R}^{\text{f16}}$  and  $\text{R}^{\text{f17}}$  which may be the same or different, is a fluorine atom or a trifluoromethyl group,  $k'$  is 0 or 1, Y is a fluorine atom or a trifluoromethyl group, and M is a hydrogen atom, an alkali metal atom or a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$  and  $\text{R}^4$  which may be the same or different, is a hydrogen atom or a monovalent organic group).

20. A fluoropolymer which is a copolymer consisting essentially of a repeating unit based on perfluoro(3-butenyl vinyl ether) and a repeating unit based on a fluoromonomer D of the following formula (II), wherein the content of the repeating unit based on the

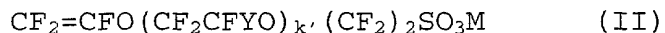
FOUAT 6362007

fluoromonomer D is from 10 to 75 mol%, and the number average molecular weight is from 5,000 to 5,000,000:



wherein  $k'$  is 0 or 1, Y is a fluorine atom or a trifluoromethyl group, and M is a hydrogen atom, an alkali metal atom or a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$  and  $\text{R}^4$  which may be the same or different, is a hydrogen atom or a monovalent organic group).

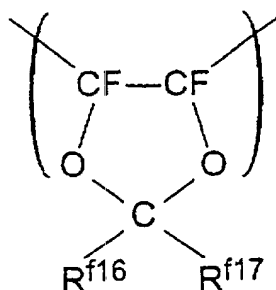
21. A fluoropolymer which is a copolymer consisting essentially of a repeating unit based on perfluoro(2-methylene-4-methyl-1,3-dioxolane) and a repeating unit based on a fluoromonomer D of the following formula (II), wherein the content of the repeating unit based on the fluoromonomer D is from 10 to 75 mol%, and the number average molecular weight is from 5,000 to 5,000,000:



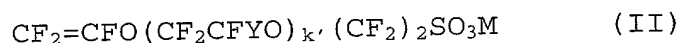
wherein  $k'$  is 0 or 1, Y is a fluorine atom or a trifluoromethyl group, and M is a hydrogen atom, an alkali metal atom or a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$  and  $\text{R}^4$  which may be the same or different, is a hydrogen atom or a monovalent organic group).

22. A fluoropolymer which is a copolymer consisting essentially of a repeating unit of the following formula (I), a repeating unit based on a fluoromonomer D of the following formula (II), and a repeating unit based on tetrafluoroethylene, wherein the content of the repeating unit of the following formula (I) is from 20 to 60 mol%,

the content of the repeating unit based on tetrafluoroethylene is from 20 to 60 mol%, and the content of the repeating unit based on the fluoromonomer D is from 10 to 40 mol%, and the number average molecular weight is from 5,000 to 5,000,000:



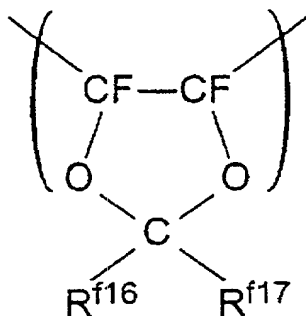
(I)



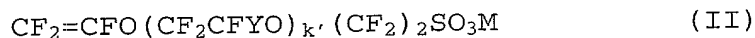
wherein each of  $\text{R}^{\text{f16}}$  and  $\text{R}^{\text{f17}}$  which may be the same or different, is a fluorine atom or a trifluoromethyl group,  $k'$  is 0 or 1, Y is a fluorine atom or a trifluoromethyl group, and M is a hydrogen atom, an alkali metal atom or a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$  and  $\text{R}^4$  which may be the same or different, is a hydrogen atom or a monovalent organic group).

23. A solid polymer electrolyte membrane which is a membrane made of a polymer electrolyte comprising a copolymer consisting essentially of a repeating unit of the following formula (I), a repeating unit based on a fluoromonomer D of the following formula (II), and a repeating unit based on tetrafluoroethylene, wherein the content of the repeating unit of the following formula

(I) is from 20 to 60 mol%, the content of the repeating unit based on tetrafluoroethylene is from 20 to 60 mol%, and the content of the repeating unit based on the fluoromonomer D is from 10 to 40 mol%, and the number  
5 average molecular weight is from 5,000 to 5,000,000:



(I)



wherein each of  $\text{R}^{\text{f}16}$  and  $\text{R}^{\text{f}17}$  which may be the same or  
10 different, is a fluorine atom or a trifluoromethyl group,  
 $k'$  is 0 or 1, Y is a fluorine atom or a trifluoromethyl  
group, and M is a hydrogen atom, an alkali metal atom or  
a group of  $\text{NR}^1\text{R}^2\text{R}^3\text{R}^4$  (wherein each of  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$  and  $\text{R}^4$   
which may be the same or different, is a hydrogen atom or  
15 a monovalent organic group).